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Point-of care sample preparation for blood microsamples

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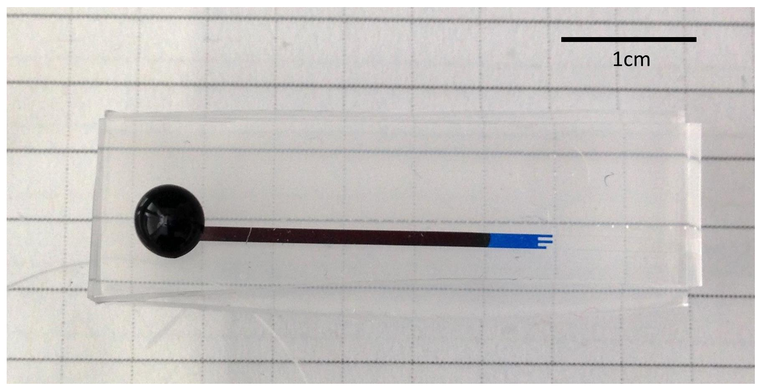
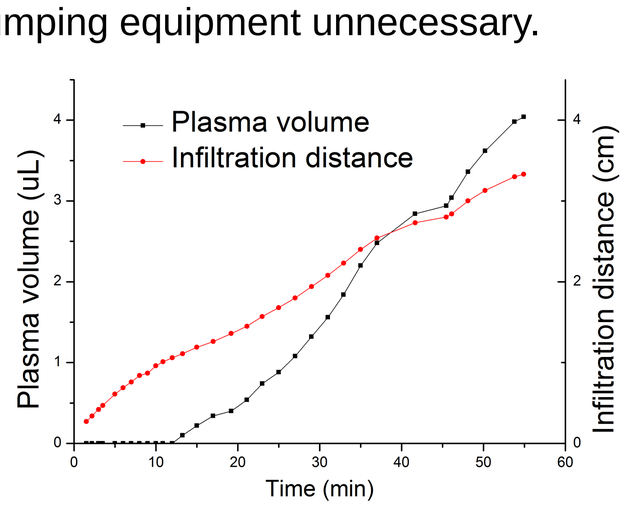
Introduction

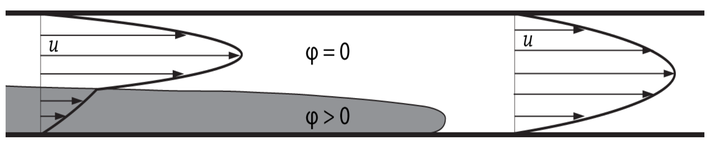
Plasma is the cell-free fraction of blood and accounts for more than 50% of the total blood volume. The analysis of its content yield essential and clinically relevant information due to the wide variety of plasmatic biomarkers. Extraction of plasma usually requires the retrieval of a large volume of blood and centrifugation steps. In this work, we propose a passive on-chip method for plasma extraction from blood microsamples from finger pricks.

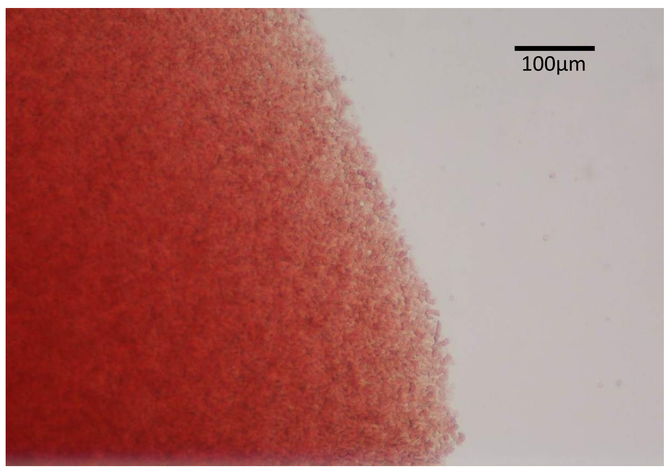


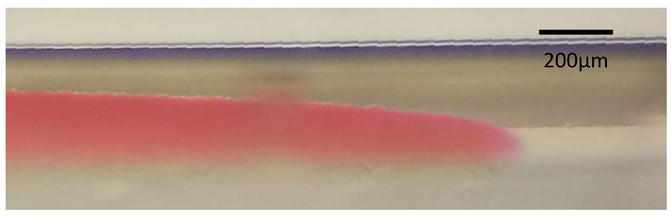
Plasma separation

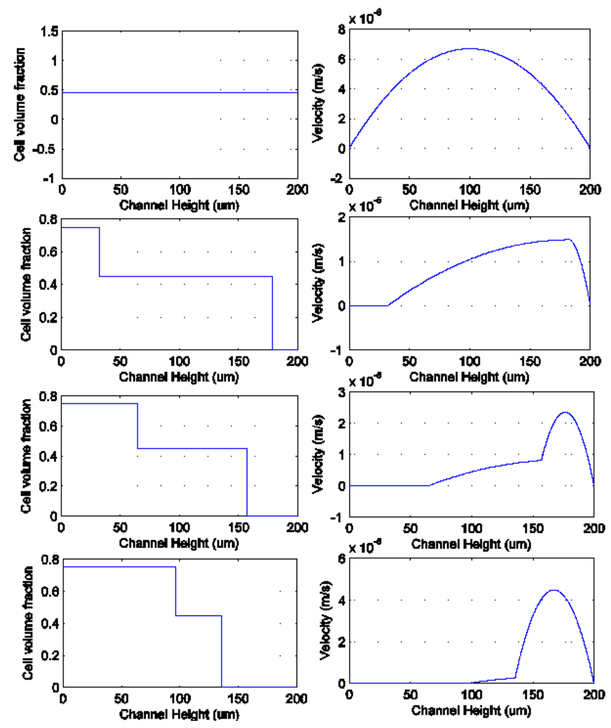
The device presented in this work separates plasma from undiluted whole blood microsamples using sedimentation. The settling of cells against the channel bottom creates a high viscosity fraction flowing at a reduced speed. In contrast, the supernatant of lower viscosity – plasma – flows at a higher velocity. This difference of flow creates a clear plasma plug in front of the concentrated cell fraction. Capillary pumping forces are generated in this device by rendering a channel surface hydrophilic and thus making external pumping equipment unnecessary.







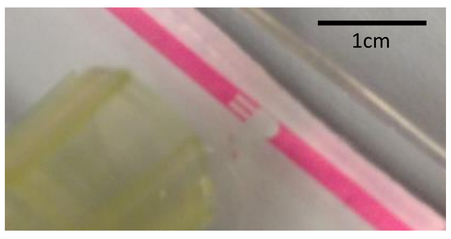




Plasma ejection

The plasma plug to be extracted is defined spatially between two capillary valves : a delay valve placed in the channel and the open end of the channel. This valving mechanism spontaneously stops the liquid thereby making the timing of the ejection not critical.

The ejection of the plasma is performed by collapsing an air cavity present in the soft material. The air is injected in the plasma storing area next to the delay valve and drives the plasma out of the device. The device is designed to eject a volume defined to be 2µL of clear plasma out of 30µL of whole blood.



Conclusion

Under microscope inspection, no cells were identified in the plasma retrieved and no hemolysis was observed during operation of the chip. Spectrophotometric measurements in Nanodrop equipment at 280nm show no major differences between plasma generated in the device and reference centrifuged samples. Comparison with bench-top techniques highlights the quality of plasma generated in the microfluidic chip.

The device presented here allows the separation of blood microsamples and can be integrated with on-chip analytical techniques. In addition to the on-chip capabilities, the plasma microsamples could be used with bench top techniques using liquid microsamples or in a dried spot format.